Part 2 -- Remarks

This Amendment and Response is responsive to the final office action mailed April 2, 2004. In that office action, claim 1 was rejected as anticipated under 35 U.S.C. 102(b) by Kasahara (4,954,850) or Takemura (5,506,442); claims 3 and 5-7 were rejected as obvious under 35 U.S.C. 103(a) over Kasahara or Takemura in view of Sze.

Reconsideration of these rejections is respectfully requested, with respect to the pending claims 1, 3 and 5-7.

Anticipation Rejection

Reconsideration of the rejection of claim 1 as anticipated by Kasahara or Takemura is respectfully requested.

Amended claim 1 requires, in the manner set forth, a doped region in a varactor, having a nonuniform dopant concentration profile that continuously increases with increasing depth of the doped region, starting from the diode junction region and continuing to a peak concentration region. Kasahara and Takemura both disclose dopant profiles that are similar to the dopant profile in U.S. Patent 3,914,708 to Stover which has been withdrawn as an anticipation reference. The doped regions in Kasahara and Takemura, like the doped region in Stover, do not have dopant profiles that continuously increase with increasing depth of the doped region. As shown in Fig. 3 in Kasahara and in Fig. 1A of Takemura the dopant profiles do not continuously increase, but instead increase for a short depth and then decrease with depth.

Furthermore, in the manner set forth, amended claim 1 requires that the continuously increasing nonuniform dopant concentration profile causes the varactor to have an approximately linear capacitance/voltage response characteristic. The capacitance/voltage response characteristics of the Kasahara and Takemura, shown in Figures 4 and 1(B) respectively, are a result of the dopant profiles of the entire doped region adjacent to the PN junctions which increase and decrease in concentration with depth from the PN junction, not from a continuously increasing nonuniform dopant concentration profile as required by amended claim 1. Moreover, the plot shown in Fig.

4

4 in Kasahara has the voltage plotted against the logarithm of the capacitance, which is not the same as having a linear capacitance/voltage characteristic.

Takemura discloses in Fig. 4(A) and in the related text, a dopant concentration profile that increases in steps with increased depth. This stepped dopant concentration profile does not continuously increase with increasing depth of the doped region starting from the diode junction. The dopant profile shown in Fig. 4(A) instead remains constant from the diode junction for a certain depth before increasing sharply. A constant region is not a continuously increasing region. Additionally, there are three distinct concentration levels where the dopant concentration does not increase but instead remains constant. Three distinct constant concentration regions, each of which is greater than its preceding region, is not a continuously increasing region. Lastly, the capacitance/voltage response of the Fig. 4(A) dopant concentration is not approximately linear, as shown in Fig. 4(B).

Since neither Kasahara nor Takemura appear to disclose a varactor with a nonuniform dopant concentration profile that continuously increases with increasing depth from diode junction and wherein the continuously increasing nonuniform dopant concentration profile causes the varactor to have an approximately linear capacitance/voltage response characteristic, as recited in the pending claims, neither Kasahara nor Takemura appear to disclose or suggest all of the elements of amended claim 1. Accordingly, neither Kasahara nor Takemura anticipates amended claim 1.

Obviousness Rejection

Reconsideration of the rejection of claims 3 and 5-7 as obvious over Kasahara or Takemura in view of Sze is respectfully requested.

Amended claim 3 requires, in the manner set forth, that the nonuniform dopant concentration profile is defined by an equation $N=Bxexp(m)$, where N is the dopant concentration, x is the depth of the doped region, B is a concentration constant and m is an exponent that determines the degree of curvature of the dopant profile, and m is greater than 1. Claim 5 requires that the exponent m is about 3.

As discussed above, neither Kasahara nor Takemura recognize that a nonuniform dopant concentration profile that continuously increases with increasing depth from a diode junction causes a varactor with an approximately linear capacitance/voltage response characteristic. Sze does not appear to teach or suggest a dopant concentration profile that increases with depth. Since none of the Kasahar, Takemura or Sze references recognize the benefit of a continuously increasing a dopant concentration with increased depth to create an approximately linear capacitance/voltage response characteristic, the combination of these references does not appear to suggest or teach this beneficial result the subject matter of claims 3 and 5-7. Accordingly, these claims are non-obvious and therefore should be patentable. In addition, claims 3 and 5-7 should be patentable in conjunction with amended claim 1 from which they depend.

Conclusion

It is believed that all pending claims in this application are in condition for allowance. Allowance is respectfully requested. The Examiner is requested to contact the undersigned by telephone to discuss any issues which may inhibit the immediate allowance of the claims.

Respectfully submitted,

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